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ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 194077

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. Date
Supplemental [ ]	B. H. Ford, Geosciences, H6-06, 376-6465	7-13-93
Direct Revision [X]	5. Project Title/No./Work Order No.: Description of Work for the 200-UP-1 Groundwater Contaminant Vertical Profiling Activity	7. Impact Level: 3Q
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Temporary [ ]	8. Document Numbers Changed by this ECN (includes sheet no. and rev.): WHC-SD-EN-AP-129, Rev. 0	10. Related PO No.
Standby [ ]	9. Related ECN No(s).: N/A	
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Cancel/Void [ ]		

11a. Modification Work	11b. Work Package No.	11c. Modification Work Completed	11d. Restored to Original Condition (Temp. or Standby ECNs only)
[ ] Yes (fill out Blk. 11b) [X] No (NA Blks. 11b, 11c, 11d)	N/A	N/A Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

Changes to text and figures. Revision of document.

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13a. Justification (mark one)	13b. Justification Details
Criteria Change [ ]	Additional review.
Design Improvement [ ]	
Environmental [ ]	
As-Found [X]	
Facilitate Const. [ ]	
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Design Error/Omission [ ]	

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DATE JUL 28 1993
Station #12

A-7900-013 (06/92)

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1): 194077

15. Design Verification Required	16. Cost Impact		17. Schedule Impact (days)
	ENGINEERING	CONSTRUCTION	
☐ Yes	Additional ☐ $	Additional ☐ $	Improvement ☐
☒ No	Savings ☐ $	Savings ☐ $	Delay ☐

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	☐	Seismic/Stress Analysis	☐	Tank Calibration Manual	☐
Functional Design Criteria	☐	Stress/Design Report	☐	Health Physics Procedure	☐
Operating Specification	☐	Interface Control Drawing	☐	Spares Multiple Unit Listing	☐
Criticality Specification	☐	Calibration Procedure	☐	Test Procedures/Specification	☐
Conceptual Design Report	☐	Installation Procedure	☐	Component Index	☐
Equipment Spec.	☐	Maintenance Procedure	☐	ASME Coded Item	☐
Const. Spec.	☐	Engineering Procedure	☐	Human Factor Consideration	☐
Procurement Spec.	☐	Operating Instruction	☐	Computer Software	☐
Vendor Information	☐	Operating Procedure	☐	Electric Circuit Schedule	☐
OM Manual	☐	Operational Safety Requirement	☐	ICRS Procedure	☐
FSAR/SAR	☐	IEFD Drawing	☐	Process Control Manual/Plan	☐
Safety Equipment List	☐	Cell Arrangement Drawing	☐	Process Flow Chart	☐
Radiation Work Permit	☐	Essential Material Specification	☐	Purchase Requisition	☐
Environmental Impact Statement	☐	Fac. Proc. Samp. Schedule	☐		☐
Environmental Report	☐	Inspection Plan	☐		☐
Environmental Permit	☐	Inventory Adjustment Request	☐		☐

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number/Revision

20. Approvals

Signature	Date	Signature	Date
OPERATIONS AND ENGINEERING		ARCHITECT-ENGINEER	
Cog. Engineer B.H. Ford	7/13/93	PE	
Cog. Mgr. D.G. Horton	7/13/93	QA	
QA W.R. Thackaberry approved per telecon	7/15/93	Safety	
Safety		Design	
Security		Environ.	
Environ.		Other	
Projects/Programs			
Tank Waste Remediation System			
Facilities Operations		DEPARTMENT OF ENERGY	
Restoration & Remediation		Signature or Letter Number	
Operations & Support Services		P. M. Park	7/13/93
IRM		ADDITIONAL	
Other		DB Goswami WA. Dept. of Ecology	7/13/93

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SUPPORTING DOCUMENT

1. Total Pages 31		
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5. Key Words tracer injection and recovery, quality assurance/quality control APPROVED FOR PUBLIC RELEASE	6. Author Name: B. H. Ford B H Ford 7/13/93 Signature Organization/Charge Code 81232/PLB52	

7. Abstract 7-21-93 D. Dole

Ford, B. H., 1993, *Description of Work for the 200-UP-1 Groundwater Contaminant Vertical Profiling Activity*, WHC-SD-EN-AP-129, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

8. ~~PURPOSE AND USE OF DOCUMENT - This document was prepared for use within the U.S. Department of Energy and its contractors. It is to be used only to perform, direct, or integrate work under U.S. Department of Energy contracts. This document is not approved for public release until reviewed.~~

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9. Impact Level 3Q

10. RELEASE STAMP

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Date Received: 7-21-93	INFORMATION RELEASE REQUEST	Reference: WHC-CM-3-4

Complete for all Types of Release

Purpose		ID Number (include revision, volume, etc.) WHC-SD-EN-AP-129, Rev. 1
[] Speech or Presentation [] Full Paper (Check only one suffix) [] Summary [] Abstract [] Visual Aid [] Speakers Bureau [] Poster Session [] Videotape	[] Reference [x] Technical Report [] Thesis or Dissertation [] Manual [] Brochure/Flier [] Software/Database [] Controlled Document [] Other	List attachments. N/A Date Release Required 7/13/93

Title Description of Work for the 200-UP-1 Groundwater Contaminant Vertical Profiling Activity	Unclassified Category UC-630	Impact Level 3Q

New or novel (patentable) subject matter? [X] No [] Yes If "Yes", has disclosure been submitted by WHC or other company? [] No [] Yes Disclosure No(s).	Information received from others in confidence, such as proprietary data, trade secrets, and/or inventions? [X] No [] Yes (Identify)
Copyrights? [X] No [] Yes If "Yes", has written permission been granted? [] No [] Yes (Attach Permission)	Trademarks? [X] No [] Yes (Identify)

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Title of Conference or Meeting N/A		Group or Society Sponsoring
Date(s) of Conference or Meeting	City/State	Will proceedings be published? [] Yes [] No Will material be handed out? [] Yes [] No
Title of Journal		

CHECKLIST FOR SIGNATORIES

Review Required per WHC-CM-3-4	Yes	No	Reviewer - Signature Indicates Approval Name (printed)	Signature	Date
Classification/Unclassified Controlled Nuclear Information	[]	[x]			
Patent - General Counsel	[x]	[]	S. W. Berglin	per OGC memo 2/4/93 mKnight	7-13-93
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Publication Services	[x]	[]	M. R. Knight	mKnight	7-13-93
Other Program/Project	[]	[x]			

Information conforms to all applicable requirements. The above information is certified to be correct.

	Yes	No	INFORMATION RELEASE ADMINISTRATION APPROVAL STAMP
References Available to Intended Audience	[x]	[]	Stamp is required before release. Release is contingent upon resolution of mandatory comments.
Transmit to DOE-HQ/Office of Scientific and Technical Information	[x]	[]	APPROVED FOR RELEASE OFFICIAL DOCUMENT NS 7-21-93
Author/Requestor (Printed/Signature) B. H. Ford	Date 7/13/93		
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Responsible Manager (Printed/Signature) D. G. Horton D. G. Horton	Date 7/13/93		Date Cancelled / Date Disapproved

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RECORD OF REVISION

(1) Document Number	
WHC-SD-EN-AP-129	Page 1

(2) Title

Description of Work for the 200-UP-1 Groundwater Contaminant Vertical Profiling Activity

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	Authorized for Release (6) Cog. Mgr. Date
0	(7) Initial release EDT 136132	B. H. Ford	D. G. Horton
1 RS	Revision of text and tables. Designated Rev. 1. Per ECN ~~136132.~~ 194077	B. H. Ford 7/13/93	D. G. Horton 7/13/93

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CONTENTS

FIGURES:

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1.0 INTRODUCTION

This description of work (DOW) details the field activities associated with assessing the vertical extent of groundwater contamination in the uppermost unconfined and confined aquifers beneath the southeastern portion of the 200 West area (Figures 1 and 2). The document serves as the test plan for those performing the work. It should be used in conjunction with the *Remedial Investigation/Feasibility Study Work Plan for the 200-UP-1 Groundwater Operable Unit, Hanford Site, Richland, Washington* (200-UP-1 Operable Unit Workplan) (DOE/RL 1992) for general investigation strategy and with *Environmental Investigations and Site Characterization Manual* (WHC 1988c) for specific procedures. Work scope for the vertical profiling activity is defined in sections 4.2 and 5.1.3 of the 200-UP-1 Operable Unit Workplan. The work is one portion of a proposed Limited Field Investigation (LFI) data collection program. This DOW was prepared in accordance with Environmental Investigations Instruction (EII) 1.14, "Preparation of Descriptions of Work" (WHC 1988c) and addresses test plan guidance found in *Standard Engineering Practices* (WHC 1988f).

1.1 SCOPE

This DOW provides technical and administrative guidance for performing single-well, multi-level samplings to assess the vertical extent of groundwater contamination beneath portions of the 200 West Area. The objective of the sampling is to isolate and sample zones within wells that have been perforated or screened over long intervals of the unconfined aquifer beneath the 200 West Area. Representative groundwater for each zone would ideally be drawn from the aquifer that is immediately adjacent to the isolated zone of the borehole being tested. The testing of each zone is designed to minimize the potential for nonrepresentative groundwater (vertical flow) mixing with the desired groundwater.

A tracer will be introduced into each well immediately before packing off and sampling discrete zones within the well. Recovery of the tracer will be monitored during the purge and sample interval for each zone and plotted versus time to evaluate whether leakage around the packer or along the annulus of the well (i.e., nonrepresentative flow) is contaminating the sample from the packed-off zone.

Field inspections and well maintenance activities will be conducted prior to individual well testing. Individual well testing will consist of pre-test groundwater collection and baselining, tracer preparation and injection, sequential packer placement and zone testing (deepest zone to shallowest), onsite evaluation of packer/well integrity (using tracer recovery results), and offsite laboratory sample analysis. Well testing will commence following approval of this document.

1.2 DATA QUALITY OBJECTIVES

Data quality objectives for this field activity are identified in the 200-UP-1 Operable Unit Workplan (DOE-RL 1992) in Chapter 4.0. Specific requirements for this activity are delineated in Table 4-6, "Data Quality Objectives for Groundwater Sampling and Analysis" (DOE-RL 1992).

Figure 1. Location of Cross Sections.

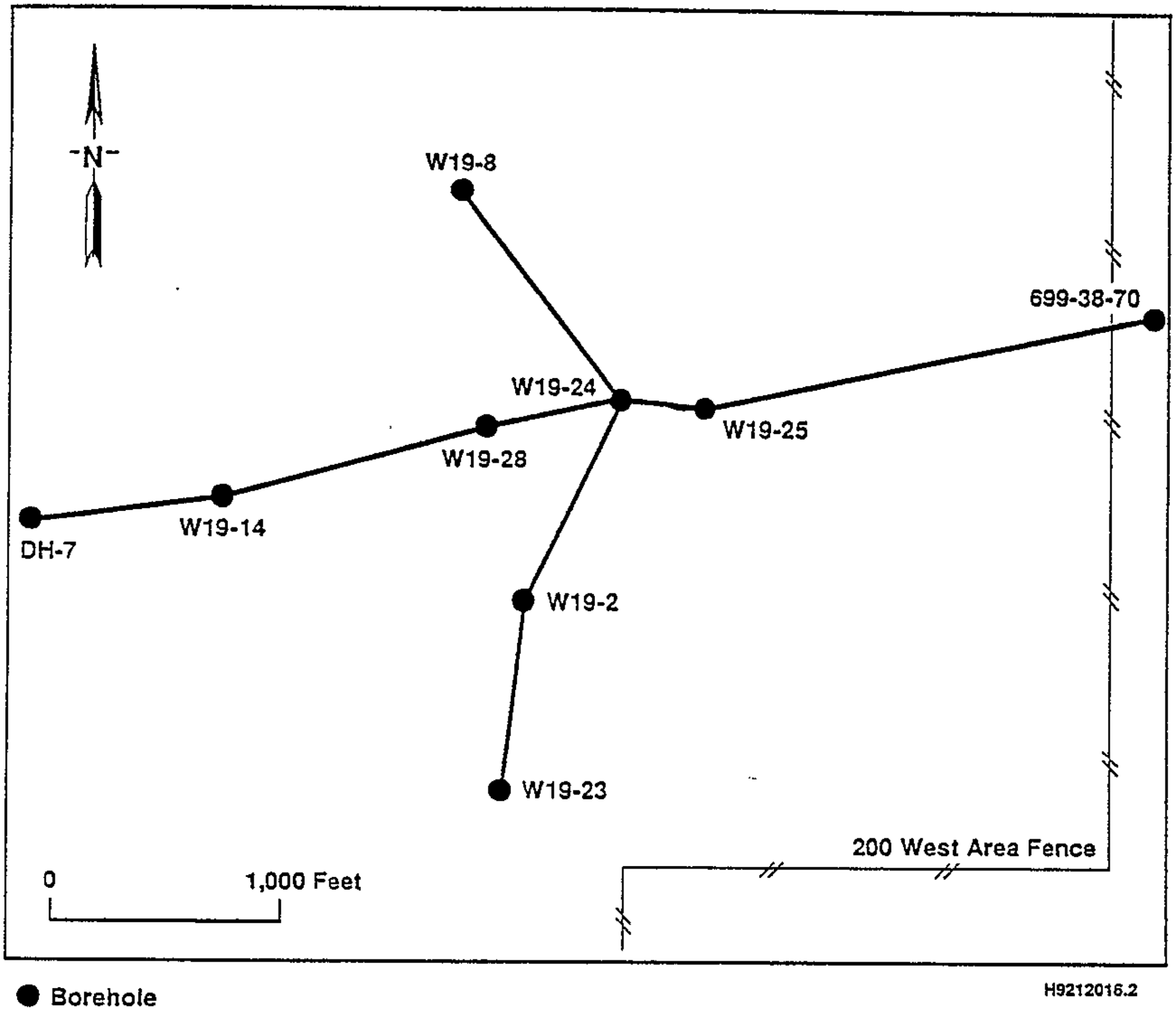
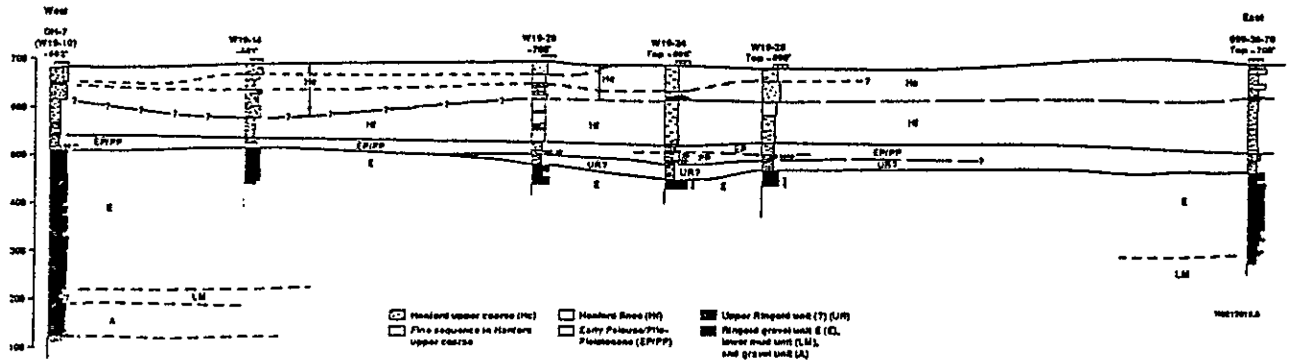
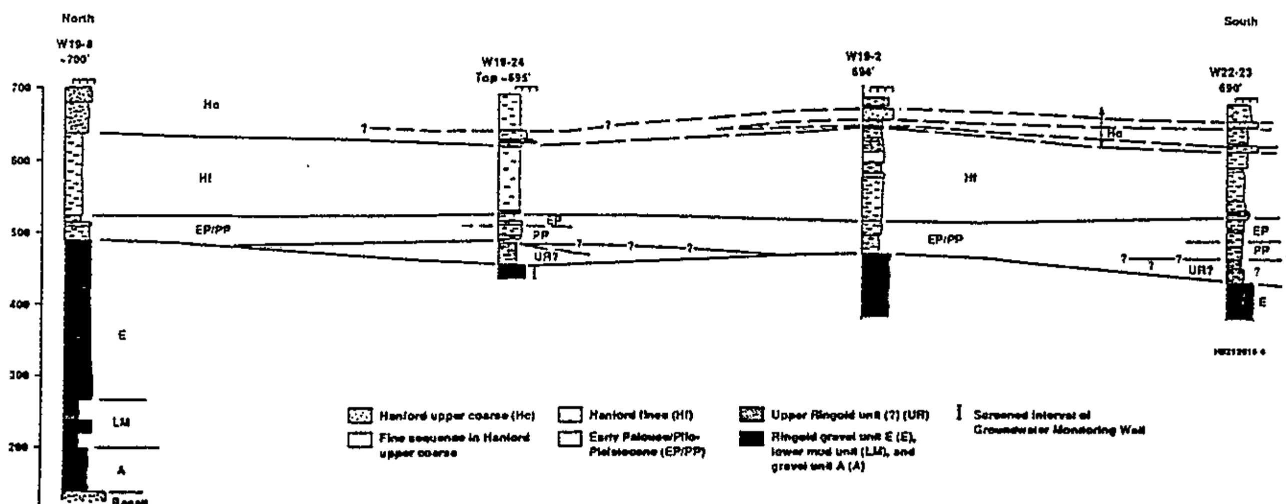


Figure 2. East-West and North-South Cross Sections
Through Study Area.





1.3 SITE SELECTION

In general, selection of test well locations is designed to be a fulfill the data requirements of the groundwater numerical model (i.e., to fill in a data gap). Prominent consideration was given to the area of uranium, tecnetium-99, and high-nitrate contamination beneath and directly east of the U-1 and U-2 cribs (located in the southeastern portion of the 200 West Area). These plumes are identified for interim remedial measures in the 200-UP-1 Operable Unit Workplan (DOE/RL 1992).

In keeping with the LFI approach, existing wells well be used in all cases. The installation of new characterization wells is costly and requires significant lead time to plan for drilling and testing. The selection criteria can be summarized as follows.

1. Only existing wells will be tested.
2. The wells must be completed at least 12 m (40 ft) beneath the present water table.
3. The well must be screened or perforated at the top of the unconfined aquifer and at the bottom of the well (at a minimum) or be configured so that perforation at these intervals is possible.
4. Testing beneath and immediately east of the U-1 and U-2 cribs is a first priority because this is the area of highest groundwater contamination.
5. The test results should fill in data gaps for the groundwater model.

Given these criteria, five test locations were selected (Table 1). Figure 3 illustrates the location of the test wells relative to the uranium, technetium-99, and nitrate plume. Attachment A contains information on the construction of these wells. Additional or alternate sites may be selected later if any of these wells proves to be unusable following field inspection and camera survey (see Section 3.2.1).

1.4 TESTING LIMITATIONS

All of the testing will be conducted using existing wells with minimum additional maintenance. In each case, zones of interest within the individual wells will be packed off and the sample will be drawn at a low pumping rate. The aim of the sampling is to confine sample inflow to the zone in the aquifer immediately adjacent to the packed-off interval (horizontal flow). As a performance check, a tracer will be introduced in the well bore and tracer recovery versus pump time (discussed in Section 3.2.4.4) will be plotted throughout each test phase to indicate any deviations from predicted recovery. Deviation from the predicted recovery curve may indicate leakage (vertical

Table 1. Summary Table of Criteria for Selecting Test Wells.

Selection Criteria	299-W19-4	299-W19-8	299-W19-18	299-W22-22	699-W38-70
Existing Well	X	X	X	X	X
Min. 40-ft. of casing below present WT	X	X[1]	X[1]	X	X
Screen/perforations at top and bottom of well (or capable)	X	X[2]	X	X	X
Beneath or east of the U-1/ U-2 Cribs	X	X	X	X	X
Fills Data Gap	X	X	X	X	X

[1] Removal of well fill material will be necessary.
[2] Well perforation will be required.

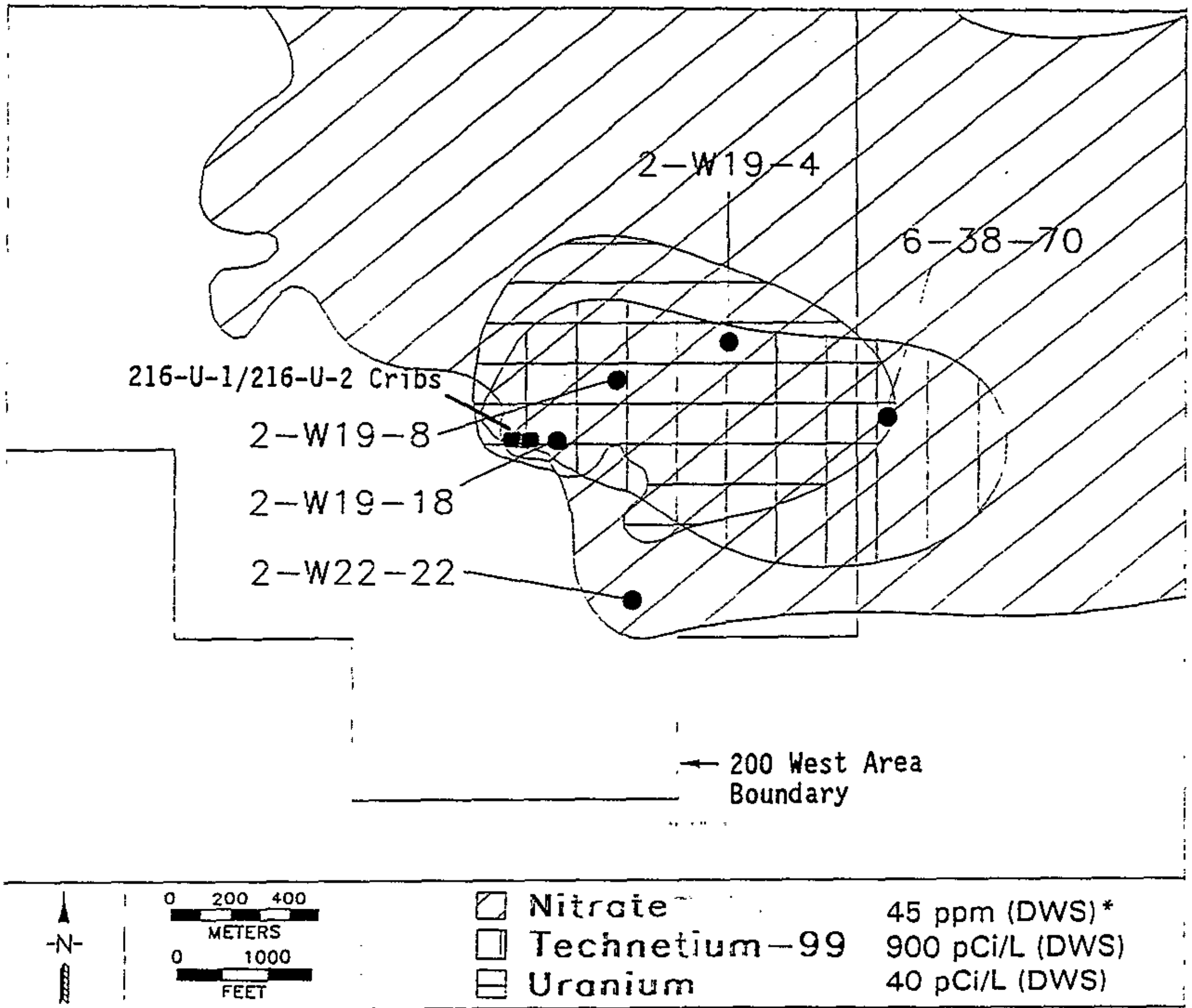
flow either around the packer or along the annulus of the well outside the casing) and non-representativeness of the sample. Some general limitations of the testing are identified below.

- Existing wells must be used; as a result, the wells will be far from ideal in terms of construction details (e.g. grouting the annulus between sample zones to retard or preclude interconnectivity). Testing methodology has been designed to minimize the potential for inducing flow in other than a horizontal direction and, as a precaution, well tracer monitoring will be conducted to possibly give an indication of non-horizontal flow.

- Due to the condition of existing wells, the vertical zone of investigation will vary. As stated in the well selection criteria, the minimum acceptable zone of interest is from the water table to 12 m (40 ft) below the water table. Well maintenance activities will be conducted to remove well fill material and increase the zone of investigation where possible.

In spite of the limitations mentioned, the wells that have been proposed for profiling are reasonably well located for examining both the vertical and lateral extent of contamination in the uranium/tecnetium-99/nitrate plumes that are of primary interest in this study. If well maintenance and sampling activities are successful, the resulting distribution of data, when combined with existing data, will more clearly define the lateral distribution of the contamination north of the cribs and will provide information on the vertical distribution near the apparent long axis of the plumes and at two points at varying distances off the axis.

Figure 3. Well Location Map.



*Drinking Water Standard

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2.0 GENERAL REQUIREMENTS

2.1 REQUIRED DOCUMENTS AND PROCEDURES

In addition to requirements identified in this document, all work will be performed in accordance with the following documents and procedures:

- WHC-EP-0383, *Environmental Engineering, Technology, and Permitting Function Quality Assurance Program Plan* (WHC 1990)

- WHC-CM-7-7, *Environmental Investigations and Site Characterization Manual* (WHC 1988c)

  - EII 1.5, "Field Logbooks"
  - EII 1.14, "Preparation of Descriptions of Work"
  - EII 5.1, "Chain of Custody"
  - EII 5.4, "Field Cleaning and/or Decontamination of Equipment"
  - EII 5.8, "Groundwater Sampling"
  - EII 5.11, "Sample Packaging and Shipping"
  - EII 6.4, "Resource Protection Well Services"
  - EII 10.3, "Purgewater Management"

- WHC-CM-7-8, Volume 4, *Environmental Engineering and Geotechnology Function Procedures* (WHC 1992)

  - Section 2.2, "Groundwater Quality Control Sampling"
  - Section 2.5, "Temperature Control of Groundwater Sample Storage Refrigerators"
  - Section 5.1, "Groundwater Measuring and Test Equipment (M&TE) Calibration by User"
  - Section 5.2, "Groundwater M&TE Calibration by WHC Standards Laboratory"

2.2 HEALTH AND SAFETY

All personnel working to this description of work will have completed the 40-hour Hazardous Waste Site Worker training program and will perform all work in accordance with the following:

- WHC-CM-4-10, *Radiation Protection* (WHC 1988e)

- WHC-IP-0692, *Health Physics Procedures Manual* (WHC 1991)

- WHC-CM-4-11, *ALARA Program* (WHC 1988a)

- WHC-CM-4-3, *Industrial Safety Manual* (WHC 1987)

- WHC-CM-7-5, *Environmental Compliance Manual* (WHC 1988b)

- Site-specific health and safety plan or job safety analysis.

3.0 SAMPLING AND FIELD ACTIVITIES

3.1 SEQUENCE OF FIELD ACTIVITIES

Field activities at each site will begin with a well assessment and, if favorable, end with the conduct of purging and sampling at various intervals within the well. Figure 4 is a generalized flow chart placing each activity in chronological order. Some of the field activities can be completed as a group; for example, most of the well assessments can be finished before any testing begins.

3.2 TEST SCHEDULE

Vertical profile sampling is expected to begin in April 1993. Testing must be completed in June 1993 to allow enough time for final data reduction and analysis and to provide input into the final modeling report that is due at the end of the fiscal year. Well assessment activities can begin at any time.

The amount of time (per well) expected to finish each field task is estimated as follows:

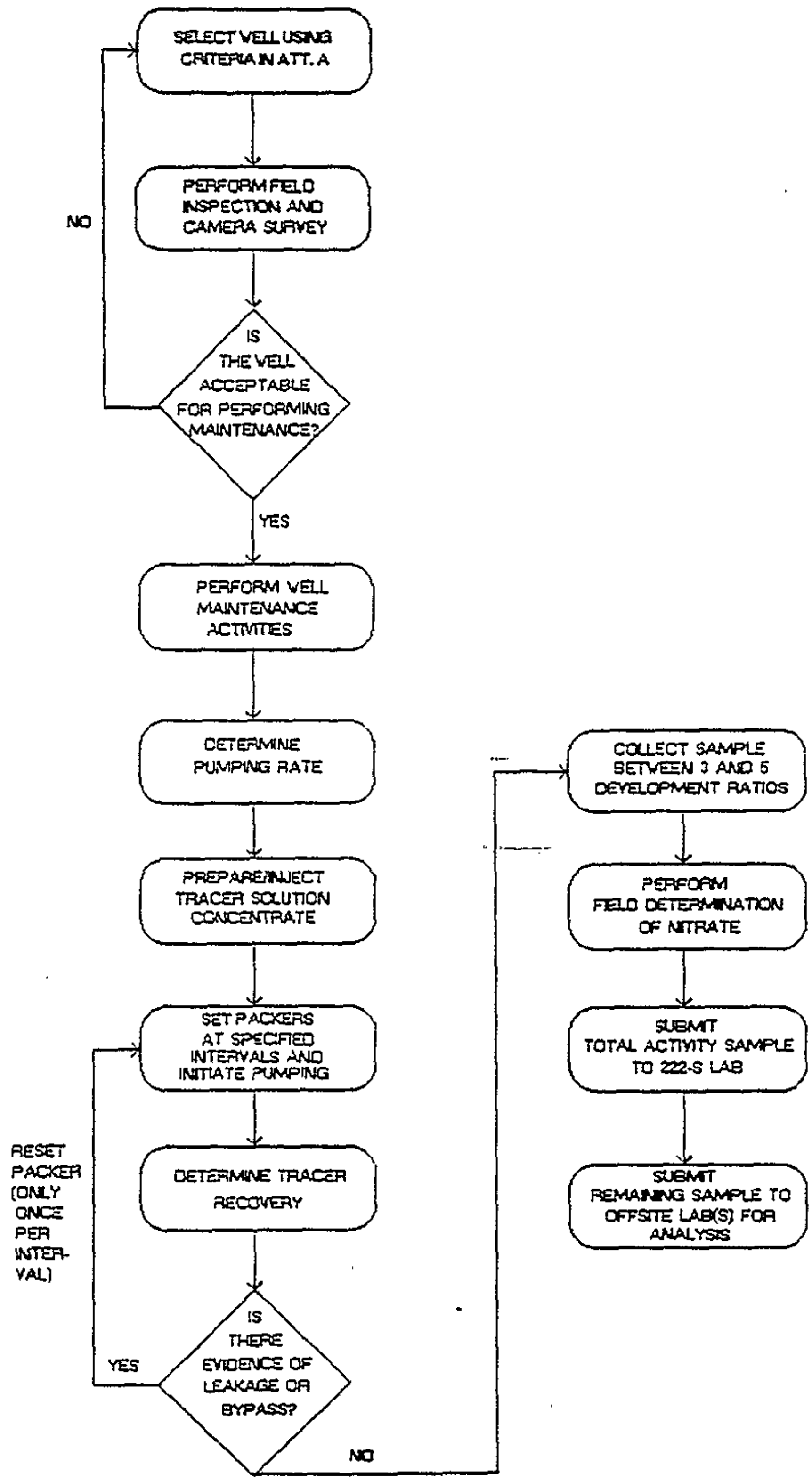
Well assessment	1 day
Well maintenance	1-2 days
Pre-test activities	0.5 day
Vertical profile testing (multiple tasks)	1-2 days
Maximum total time/well	5.5 days

The following subsections describe specific requirements for the vertical profiling such as determination of pumping rate, tracer injection and mixing, packer placement, test duration, tracer recovery determination, and sample collection and handling.

3.2.1 Well Assessment

A well assessment per EII 6.4, "Resource Protection Well Services" (WHC 1988c) will be performed at each proposed well to determine its suitability for testing. This assessment will include a field inspection and camera survey. Subsequent to the well assessment, wells will be either (1) rejected as unfit for use, (2) accepted conditionally for use subject to additional well maintenance activities, or (3) accepted unconditionally for use. If one or more of the proposed wells is inadequate for testing, alternate locations may be chosen. Alternate wells will be chosen according to the criteria described in Section 1.3 and tested using the approach described in this test plan. Examples of conditions that would result in a well's being classified as unacceptable include weak or collapsed casing, exceptionally corroded or mineralized perforated zones, inability to remove well fill material, inability (because of well condition) to reasonably ensure packer sealing capability, or inability to perforate a well (where necessary).

Figure 4. Flow Chart of Vertical Profiling Activities.



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3.2.2 Well Maintenance

Well maintenance activities may include, but are not limited to, well scrubbing and redevelopment, well perforation or reperforation, and removal of accumulated sand and silt. These activities will be conducted in accordance with the requirements of EII 6.4, "Resource Protection Well Services" (WHC 1988c).

3.2.3 Pretest Activities

Following well maintenance activities and in advance of the day that the vertical profiling is conducted, a one-liter sample (unfiltered) will be collected for bromide analysis. The sample should be run on a rapid turnaround basis. In addition, sufficient water (a minimum of 10 L [2.6 gal]) will be collected for use in the preparation of calibration standards (see Section 3.2.4.4). Groundwater should be collected and handled as specified in EII 5.8, "Groundwater Sampling" (WHC 1988c).

3.2.4 Vertical Profiling Test Activities

Attachment B contains the general procedure to be followed to perform a vertical profiling test. Details of the current proposed activity are provided in the sections that follow.

3.2.4.1 Tracer Injection and Mixing. The ideal tracer for the proposed methodology should be conservative, nontoxic, inexpensive, and easily detected with relatively simple equipment. In addition, the tracer must be present in concentrations well above background for the same constituent in the aquifer. Lastly, the tracer should not modify any property of the aquifer. Lithium bromide meets all of the specified criteria. The bromide ion will be the tracer of interest during field measurements of recovery.

Bromide concentrations have been measured during 1992 in two of the six proposed test wells (Wells 2-W19-18 and 6-38-70). Both wells were reported to have less-than-detectable (<500 ppb) concentrations. Forty-three other wells in the vicinity of the test wells have similar results (34 wells <500 ppb, 9 wells <1,000 ppb). The instrument detection limit for a bromide ion-specific electrode at 400 ppb is very close to the reported detection limit. Therefore, it should be relatively easy to recognize the bromide tracer during purge-and-sample operations as long as the initial concentration is high enough to allow for the measurement of the tracer throughout the entire sampling period. These tests will be conducted using a initial tracer concentration of 50 ppm (50,000 ppb) to ensure detectability by field instrumentation.

Determining the bromide solution concentrate to be prepared for each well is dependent on the volume of groundwater within the casing of the well and the affected annular space. This volume will vary from well to well. The general calculation is described in Attachment B (Appendix A, Section 3.1.1) with an example calculation for a well with a 9-in. borehole completed with an 8-in. casing and containing a 30-m (100-ft) water column. Calculations for each well will not be possible until after the completion of well maintenance activities because an exact depth-to-bottom for each well will not be known until that time. The bromide solution should be prepared prior to going into the field.

The bromide solution should be prepared in small volume containers (e.g. 1 L). In the field, the containers are to be held in a water bath to adjust solution temperatures to ambient groundwater temperature. Each container of solution will be gravity-fed through a weighted, small-diameter hose into the well at discrete intervals of no greater than 3 m (10 ft) starting from the water table downward. For example, if the water column in a well is 30 m (100 ft), a minimum of ten 1-L bromide solutions should be prepared. The first liter will be poured through the hose at the top of the water table. The hose will then be lowered 3 m (10 ft) and the next liter will be added to the well water. The process will be continued until the last bottle is poured 3 m (10 ft) above the bottom of the well. The hose will then be removed from the well and the well water will be <u>gently</u> surged to ensure even mixing and to force the tracer fluid into the annulus. Once this action is complete, setting of the packer and purge and sampling activities can proceed.

3.2.4.2 Packer Placement. The packer assembly will be designed to isolate a 1.5-m (5-ft) interval. At a minimum (if length of water column allows), each well will be sampled at three intervals: at the water table to 1.5 m (5 ft) below the water table, at 9 to 10.6 m (30 to 35 ft) below the water table, and at the bottom of the well. Packer placement (and consequently sampling) will begin at the deepest interval and proceed to the shallowest. If no contamination is detected at or below the 9 to 10.6 m zone, additional shallower intervals may be added as time allows but it is not a requirement of this investigation.

3.2.4.3 Test Duration. Each interval will be pumped at a maximum rate of 3.78 L/min (1 gal/min). Tracer recovery determinations will be conducted throughout each test as described in Section 3.2.4.4. Samples for laboratory analysis and onsite determination of nitrate (see Section 3.2.4.5) will be collected between 3 and 5 development ratios (time will vary from well to well). Every attempt should be made to complete all sampling intervals in a single day. If a well cannot be completed in one day, the well must be totally purged for a minimum of three development ratios or until bromide is undetectable with field instrumentation. The well can then be retagged with tracer solution and sampling can be continued on another day.

3.2.4.4 Tracer Recovery Determination. Bromide ion concentration can be measured using a high-impedance millivolt meter, a bromide ion-selective electrode, and a double-junction reference electrode. Prior to going into the field, a 1,000 mg/L bromide standard solution (lithium bromide and distilled water) will be prepared. Using water from the well (collected during pumping rate determination) a set of standards at 0.3, 1.0, 3.0, 10.0, 30.0, and 100.0 mg/L will be prepared. Using the electrodes and meter, the millivolt response for each standard will be recorded. No ionic-strength adjustment is needed for these measurements. A calibration curve will be prepared by plotting millivolts versus the log of the concentration.

In the field, the discharge stream is to be sampled (500-mL, unfiltered, no preservative) immediately after pump startup and then at 5-minute intervals until the laboratory sample is drawn. (Note: For an 8-in. casing/9-in. nominal borehole that is pumped at 3.78 L/min [1 gal/min], it will take 14.1 minutes to equal one development ratio.) Measurement of bromide is conducted by pouring approximately 50 mL of the sample into a clean beaker and inserting the electrodes into the sample. The millivolt response is recorded and the calibration curve is used to estimate concentration. Electrodes must be rinsed with deionized water between measurements. After completion of the test, the remainder of the samples are submitted to the laboratory for bromide determination as a check on field measurements.

The bromide results should be plotted on a predicted recovery plot (log concentration versus DR) to make a field evaluation as to whether there may be packer leakage or annular bypass. If leakage or bypass is evident or suspected, the test may be interrupted and the packer reseated if it is deemed possible. Packer reseating should be performed only once in the interest of completing the test in a timely manner.

3.2.4.5 Sample Collection and Handling. A sample is to be collected between three and five development ratios for metals (filtered and unfiltered), anions, volatile organics, technetium-99, total uranium (chemical), total activity, and nitrate (field determination). The list of analytes is summarized in Table 2. The sample will be collected and handled using the protocols defined in EII 5.8, "Groundwater Sampling" (WHC 1988c). A field determination of nitrate will be conducted at the site. Total activity samples will be submitted to the 222-S Laboratory for analysis. The remainder of the samples will be shipped offsite for analysis.

Table 2. List of Analytes

Analyte	Method	Holding Time	Bottle/Volume
ICP/AA Metals	CLP	6 Months	P 1000 mL
Anions		28 Days	aG 250 mL
VOA	CLP	14 Days	aG 40 mL (3)
Radionuclides	Lab SOP	6 Months	P 2000 mL
•Tc-99			
•Total U			
Total Activity	Lab SOP	6 Months	G 250 mL
Field Nitrate	Field Method	14 Days	G 250 mL

AA = Atomic Absorption
CLP = Contract Laboratory Program
ICP = Inductively Coupled Plasma
SOP = Standard Operating Procedure
VOA = Volatile Organic Analysis
G = Glass
aG = Amber Glass
P = Plastic

3.2.4.5 Analyses. Samples shipped to the offsite laboratory(s) should have analyses performed using Level IV CLP or Level V methodologies (as applicable). Sample custody will follow procedures as outlined in EII 5.1, "Chain of Custody" (WHC 1988c). Priority turnaround (10-day) may be specified as necessary to expedite the receipt of results for use in groundwater model development.

4.0 QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

Data quality is controlled by this DOW. The data at the test wells can be reproduced if the initial test fails by re-running the test. The quality assurance documents that cover the test activities are the *Quality Assurance Manual* (WHC 1988d), and the *Environmental Engineering, Technology, and Permitting Function Quality Assurance Program Plan* (WHC 1990). This test plan and the vertical profile testing is assigned an impact level of 4.

Quality control samples should be collected at the following frequency:

(1) One duplicate for every 10 groundwater sample or a minimum of one per well

(2) One split sample

(3) One (VOA) trip blank per well.

5.0 SCHEDULE

The following is a projected schedule for July-September, 1993. This schedule is subject to change and the operable unit coordinator should be contacted for current status. An Agreement Activity Notification form will be issued at least 5 days prior to start of field work.

WELL	WELL ASSESSMENT	WELL MAINTENANCE	PRETEST ACTIVITIES	WELL TEST
299-W19-4	MAR-APR 1993	APRIL 1993	JUL-AUG 1993	AUG-SEP 1993
299-W19-8	MAR-APR 1993	APRIL 1993	JUL-AUG 1993	AUG-SEP 1993
299-W19-18	MAR-APR 1993	APRIL 1993	JUL-AUG 1993	AUG-SEP 1993
299-W22-22	MAR-APR 1993	APRIL 1993	JUL-AUG 1993	AUG-SEP 1993
699-38-70	MAR-APR 1993	APRIL 1993	JUL-AUG 1993	AUG-SEP 1993

6.0 REVISION/CHANGE TO THE DESCRIPTION OF WORK

Revision/changes to an approved DOW are to be processed in accordance with EII 1.14.

7.0 REFERENCES

DOE-RL, 1992, *Remedial Investigation/Feasibility Study Work Plan for the 200-UP-1 Groundwater Operable Unit, Hanford Site, Richland, Washington*, DOE/RL 90-08, U. S. Department of Energy, Richland Field Office, Richland, Washington.

Driscoll, F. G., 1986, *Groundwater and Wells*, Second Edition, Johnson Filtration Systems, Inc., St. Paul, Minnesota.

WHC, 1987, *Industrial Safety Manual*, Vol. 1 through 3, WHC-CM-4-3, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988a, *ALARA Program*, WHC-CM-4-11, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988b, *Environmental Compliance Manual*, WHC-CM-7-5, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988c, *Environmental Investigations and Site Characterization Manual*, WHC-CM-7-7 Westinghouse Hanford Company, Richland, Washington.

WHC, 1988d, *Quality Assurance Manual*, WHC-CM-4-2, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988e, *Radiation Protection*, WHC-CM-4-10, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988f, *Standard Engineering Practices*, WHC-CM-6-1, Westinghouse Hanford Company, Richland, Washington.

WHC, 1990, *Environmental Engineering, Technology, and Permitting Function Quality Assurance Program Plan*, WHC-EP-0383, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991, *Health Physics Procedures Manual*, WHC-IP-0692, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992, *Environmental Engineering and Geotechnology Function Procedures*, WHC-CM-7-8, Volume 4, Westinghouse Hanford Company, Richland, Washington.

ATTACHMENT A

WELL CONSTRUCTION SUMMARY INFORMATION

Table A-1. Well Construction Summary Information for the Vertical Profiling Test Wells (see Figure 1 for locations).

PERMANENT WELL #	END DRILLING DATE	COMPLETION DEPTH (ft)	TOTAL DEPTH (ft)	DEPTH TO WATER (ft)	SCREEN INTERVAL (ft)	ELEVATION TOP OF CASING	CASING SIZE (IN)	CASING MATERIAL
299-W19-4	FEB 60	550	421[1]	256 (6/91)	255-443P 465-485P 520-535P	715	8"-539	CS
299-W19-8	JUN 71	585	244[2]	DRY	NONE	700	6"-560	CS
299-W19-18	DEC 85	362	259[2]	233 (5/91)	230-240 265-270 315-320 350-355	ND	6"-235 5"-362	CS CS
299-W22-22	JUL 60	301	301	231 (6/92)	225-300P	690	8"-301	CS
699-38-70	JUN 57	413	300[3]	259 (12/91)	255-380P	711	8"-388	CS

P=Perforations
CS=Carbon Steel
ND=Not Documented
[1] Total depth indicated reflects well fill.
[2] Total depth indicated reflects well fill which must be removed (partially or totally) before testing.
[3] A cement plug was installed subsequent to well installation.

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ATTACHMENT B

Vertical Profile Testing Procedure

1.0 PURPOSE

This procedure provides instructions and requirements for performing vertical profile testing.

2.0 SCOPE

This procedure applies to groundwater sampling activities to define the vertical extent of contamination using existing wells with long perforated or screened intervals.

3.0 DEFINITIONS

Straddle packer--a mechanical device that can be inserted into a test well to isolate a test zone.

Test location--a well that is selected for vertical profiling.

Test zone--a specific interval within a test well that is identified for packing off and sampling.

4.0 RESPONSIBILITIES

4.1 FIELD TEAM LEADER/COGNIZANT ENGINEER

The Field Team Leader (FTL) or Cognizant Engineer, hereafter referred to as the FTL, is responsible for the following:

1. Directing all field operations from pre-test sample collection and tracer preparation through mobilization at the testing site and completion of decontamination and demobilization,
2. Coordinating subcontracted onsite activities (when applicable),
3. Handling and disposing of purgewater in accordance with Environmental Engineering Instruction (EII) 10.3, "Purgewater Management,"
4. Collecting and handling groundwater samples in accordance with EII 5.8, "Groundwater Sampling."

4.2 VERTICAL PROFILING TEST LEAD

The Vertical Profiling Test Lead is responsible for performing the vertical profile testing and completing the specified test documentation in accordance with the applicable appendix of this procedure.

5.0 REQUIREMENTS

5.1 SAFETY REQUIREMENTS

Aquifer testing activities shall comply with the site-specific health and safety documents.

5.2 SITE-SPECIFIC TEST REQUIREMENTS

Site-specific requirements such as test location, testing zones, tracer selection, straddle packer interval, and analytes of interest will be provided as needed by individual site Sampling and Analysis Plans, Description of Work, or Groundwater Monitoring Plan (or equivalent work-controlling document).

5.3 DISPOSAL OF DISCHARGED WATER

Groundwater discharged from a well during vertical profile testing shall be disposed of in accordance with EII 10.3, "Purgewater Management."

5.4 DECONTAMINATION

Decontamination of downhole test equipment and components shall be conducted in accordance with EII 5.4, "Field Decontamination of Drilling, Well Development and Sampling Equipment."

5.5 TESTING EQUIPMENT CALIBRATION STATUS AND FUNCTION VERIFICATION

Equipment calibration status shall be verified prior to use and documented on the appropriate forms or in the field logbook.

6.0 PROCEDURE

This procedure is limited to technical activities related to vertical profile testing and the methodology is described in Appendix A. Specific requirements for recording test data are included in the appendix.

6.1 RECORDS

Vertical profile testing is documented through the use of three records:

1. Field logbooks
2. Groundwater Sample Reports (see EII 5.8)
3. Tracer recovery graphs.

While a profile test is in progress, these records shall be protected and stored as defined in EII 1.5, "Field Logbooks," and EII 1.6, "QA Record Processing," Upon completion of the testing, the Groundwater Sample Report and tracer recovery graph(s) are considered lifetime quality assurance records and shall be transmitted to the Field File Custodian for transmittal to

Information Resources Management for permanent storage in accordance with WHC-CM-3-5, Section 5.

7.0 REFERENCES

WHC, 1988a, *Document Control and Records Management*, Section 5, WHC-CM-3-5" Records Storage, Retrieval and Destruction," Westinghouse Hanford Company, Richland, Washington.

WHC, 1988b, , *Environmental Investigations and Site Characterization Manual.* WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

APPENDIX A

VERTICAL PROFILE TEST METHOD

1.0 DISCUSSION OF METHOD

Vertical profile testing is conducted using existing wells with minimum additional maintenance. Zones of interest within individual wells are packed off and the sample is collected at a low pump rate. The aim of the sampling is to confine sample inflow to the zone in the aquifer immediately adjacent to the packed-off interval (horizontal flow). As a performance check, a tracer is introduced in the well and tracer recovery versus pump time is plotted throughout each test phase to indicate any deviations from predicted recovery. Deviation from the predicted recovery curve may indicate leakage (vertical flow either around the packer or along the annulus of the well outside of the casing) and non-representativeness of the sample.

2.0 EQUIPMENT REQUIREMENTS

Vertical profile testing equipment may include, but is not limited to, the following. The required specifications listed after each item must be recorded in the field logbook or Groundwater Sample form (EII 5.8).

1. pH/Temperature Meter and Probe. Record the make, model, identification number, and calibration date.

2. Conductivity Meter and Probe. Record the make, model, identification number, and calibration date.

3. Tracer Ion-Specific Electrode and Meter. Ion-specific electrode will be as specified in the applicable work-controlling document. Record the make, model, identification number, and calibration date.

4. Standardized Electrical Water-Level Measurement Tape. Record the make, model, identification number, and calibration date.

5. Mechanical Pump. Record the type, make, model, identification number, and horsepower rating (if applicable). The pump should have a characteristic curve available.

6. Straddle Packer Assembly. Record the packer type(s) and physical configuration.

The field equipment must be calibrated or standardized as follows:

- pH/Temperature Meter. Calibrate per requirements identified in WHC-CM-7-8, Volume 4, Section 5.1, "Groundwater Measuring and Test Equipment (M&TE) Calibration by User."

- Conductivity Meter. Calibrate per requirements identified in WHC-CM-7-8, Volume 4, Section 5.1, "Groundwater Measuring and Test Equipment (M&TE) Calibration by User."

- Ion Specific Meter. Calibrate per manufacturer's instruction. Accuracy: +/- 3% of reading (monovalent ions) or +/- 5% of reading (divalent ions).

- Standardized Electric Water-Level Measurement Tape. +/- 0.10 ft of a calibrated electric tape.

- Calibrated Electric Water-Level Measurement Tape. +/- 0.2 percent over the total tape length, traceable to the National Bureau of Standards.

- Straddle Packer Assembly. Minimum requirement at each test well is the ability to inflate to the diameter of the borehole in the testing intervals. Packers are to be set to straddle a 5 +/- 0.5 ft interval.

3.0 PROCEDURE

This section describes the test methods to be used in conducting the vertical profile testing. All information and data collected during the test will be recorded in the field logbook, Groundwater Sample Report form, or on a tracer recovery diagram.

3.1 PRE-TEST ACTIVITIES

3.1.1 Tracer Solution Preparation

Prior to the sample day, and following well maintenance activities, a determination of the tracer solution concentrate to be prepared for each well must be completed. Calculations for each well is not possible until after the completion of well maintenance activities because an exact depth-to-bottom for each well will not be known until that time. The tracer of interest, and the concentration, will be specified in the controlling work document. The general calculation is to be conducted as follows:

(1) Calculate the height of the water column in the well casing. Using standard well purge tables (e.g. Driscoll, 1986, Appendix 11.L) calculate the volume of water in the casing (in liters).

(2) Based on well diagrams, determine the nominal diameter of the borehole. Again using standard well purge tables determine the volume within the borehole.

(3) Subtract (~~2~~ 1) from (~~1~~ 2) and multiply the result by .30 to obtain an estimate of pore volume within the annular space (.30 is an estimate based on the assumption that the annular space is disturbed and poorly compacted).

(4) Add (1) and (3) to obtain an estimate of the total volume of water in the casing and annulus.

(5) Mix the tracer solution, using the volume calculated in step (4), which will result in an initial tracer concentration equivalent to the requirement specified in the controlling work document. Assume that the tracer will be evenly mixed throughout the casing plus annular water volume.

An example calculation for a lithium bromide tracer (50 ppm concentration) in a well with a 9-in. borehole completed with 8-in. casing and containing a 100-ft water column is presented in Appendix B.

At any time during the five days prior to the actual vertical profile testing at a well, prepare the tracer solution in 1-L plastic containers . Prepare enough containers to be equal to the depth of the water column (in feet) divided by 10. [Example for well with 100-ft water column: 100 ft/10 = 10 bottles]. The methodology for preparing the solution is as follows:

(1) Fill a clean 1-L plastic bottle one-half full of deionized (DI) water.

(2) Divide the calculated mass of tracer by the number of bottles.

(3) Weigh out the mass of tracer calculated in Step 2 on a calibrated, top-loading balance and add to the half-filled bottle.

(4) Fill the bottle with DI water to within 1-in. of the top of the bottle.

(5) Cap the bottle and agitate until visible dissolution of all of the added tracer is complete.

(6) Repeat the process until all bottles are filled.

(7) Store the bottles in a secure refrigerator until required in the field.

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3.1.2 Tracer Calibration Standards Preparation

At least three days prior to a well test day, visit the well and collect sufficient groundwater to allow preparation of tracer calibration standards (minimum of 10 L [2.6 gal]).

In the laboratory, prepare a 1000 mg/L standard solution (tracer and DI water). The procedure is as follows:

(1) Determine the weight fraction of the tracer constituent using:

$$\frac{\text{Atomic weight of tracer constituent}}{\text{Formula weight of tracer compound}} = \begin{array}{l}\text{weight fraction of}\\ \text{tracer constituent}\end{array}$$

(2) Multiply:

1000 mg X (1/weight fraction of tracer constituent)

to determine the weight of tracer compound to be mixed with DI water.

(3) Add 500-mL DI water to a clean 1000-mL volumetric flask.

(4) Weigh out the mass of tracer compound calculated in Step 2 on a calibrated, top-loading balance and add to the half-filled flask.

(5) Fill the flask to 1000-mL. Stir and dissolve tracer compound completely.

(6) Pour solution into a clean, 1-L plastic container and label.

Once the standard solution has been prepared, prepare a set of 500 mL calibration standards at 0.3, 1.0, 3.0, 10.0, 30.0, and 100.0 mg/L. The general procedure is as follows (using 100 mg/L as an example):

(1) Solve for the stock standard volume using:

Volume (stock standard) X Concentration (stock standard)
= Volume (calibration standard) X Concentration (cal. standard)

For example:

Stock standard concentration	= 1000 mg/L
Stock standard volume	= ?
Calibration standard concentration	= 100 mg/L
Calibration standard volume	= .5 L

$$? \times 1000 \text{ mg/L} = .5 \text{ L} \times 100 \text{ mg/L}$$
$$? = .05 \text{ L (or 50 mL)}$$

(2) Using a clean 500-mL graduated cylinder, measure out the required volume of stock standard. Fill the cylinder with well water to 500-mL.

(3) Transfer the solution to a clean 500-mL plastic container.

(4) Repeat the process for the next calibration standard.

(5) Prepare a calibration curve by plotting millivolt response of the ion-specific electrode versus the log of the concentration.

(5) Store calibration standards in a secure refrigerator until required in the field.

3.2 TEST PROCEDURE

On the day of the vertical profile test the following steps are to be followed in the field:

(1) Place 1-L tracer solution bottles in a constant-temperature water bath at 18-22°C until needed.

(2) Measure the depth-to-water in the well using the electric tape as directed in EII 10.2, and record the depth-to-water (to the nearest 0.1 ft) and time.

(3) Lower a small-diameter hose to the water table.

(4) Pour 1 L of tracer solution into the tube. Attach the tube to a regulated argon (or any noble gas) cylinder. Using the applicable pressure indicated in the table below, bubble the tracer solution out of the hose for 1 minute.

Depth below Water Table (ft)	0	10	20	30	40	50	60	70	80	90
Pressure (psi)	~1	4.5	9	13.5	18	22.5	27	31.5	36	40.5

* For depths not shown, the pressure is calculated by: depth (in feet) X .45 psi/ft.

(5) Detach the hose from the gas cylinder. Lower the hose 10 ft and repeat step 4. Continue process until all tracer solution has been introduced into the well.

(6) Remove hose from well.

(7) Surge the well <u>very gently</u> with an appropriate diameter slugging tool for 3 minutes to mix the tracer.

(8) Set and inflate the straddle packer at the deepest interval specified for the well.

(9) Set the sample pump inside the packer tubing string at 2.5 ft below the water table.

(10) Begin to purge at less than 1 gal/min (based on the rate of filling a 5-gal bucket).

(11) Collect a 500-mL (unfiltered, no preservative) sample immediately after startup and at every 0.5 develpment volume as directed by the Vertical Profiling Test Lead.

(12) Pour approximately 50-mL of the sample into a clean beaker and determine the millivolt response of ion-specific electrode. Compare the response to the calibration curve to estimate the concentration. Store the remainder of the sample for later laboratory analysis of the tracer.

(13) Provide the estimated concentration information to the Vertical Profiling Test Lead who will plot the tracer concentration on a predicted recovery plot (log concentration versus development ratio). If the actual recovery deviates significantly from the predicted recovery, the Vertical Profiling Test Lead can, based on his evaluation, (1) continue the test, (2) stop the test and reset the packer, or (3) stop the test completely. The packer may be reset only once per sampling interval.

(14) At the direction of the Vertical Profiling Test Lead, a laboratory sample will be collected (ideally between 3 and 5 development ratios).

The sample will be collected for the parameters specified in the controlling work document and per the requirements of EII 5.8.

(15) Once the laboratory sample has been collected, stop the pump and reset the packer at the next test interval and repeat the testing at step 9 until all intervals are tested.

REFERENCES

Driscoll, F. G., 1986, *Groundwater and Wells*, Second Edition, Johnson Filtration Systems, Inc., St. Paul, Minnesota.

WHC, 1992, *Environmental Engineering and Geotechnology Function Procedures*, WHC-CM-7-8, Volume 4, Westinghouse Hanford Company, Richland, Washington.

APPENDIX B

Example Tracer Solution Calculation

Given:
- 8-inch diameter casing
- 9-inch diameter borehole (nominal)
- 100-foot water column

Conversion information:
- liters/foot for 8-inch diameter - 9.88
- liters/foot for 9-inch diameter - 12.51

Calculation of volume of water in casing and annular pore space:

Casing volume:	100 ft X 9.88 l/ft	= 988 l	(1)
Borehole volume:	100 ft X 12.51 l/ft	= 1251 l	(2)
Annulus volume ((2) - (1)):		= 263 l	(3)
Annular pore volume:	263 l X 0.30	= 79 l	(4)
Total volume ((1) + (4)):		= 1067 l	(5)

Determination of tracer solution concentration:
- Mass of tracer for 50 ppm concentration in 1067 l: 53.4 g
- Mass (of Bromide) added to each of 10 1-liter deionized water containers: 5.34 g
- Mass of LiBr added to each liter of deionized water: 5.76 g

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